FIELD OF THE INVENTION

The present invention relates to an assembly for controlling a stopper belonging to a continuous casting installation, as well as to a continuous casting installation provided with such a control assembly.

BACKGROUND OF THE INVENTION

The first step of a continuous casting operation conventionally consists in pouring molten metal into a basin, also called tundish, from a ladle. This tundish is, in addition, provided with a stopper.

When the molten metal has reached a given level in the tundish, it is then poured into a mould, under the effect of a movement of release of the stopper. This then initiates a phase of filling of the mould until a given reference level is reached.

According to a first variant, it is firstly known to start up this continuous casting manually. However, in addition to its relative lack of repetitivity, this solution requires the intervention of at least one operator.

In order to overcome these drawbacks, it has been proposed to effect the afore-mentioned start up automatically. In this spirit, the stopper is driven by means of a control assembly, also called actuator, in a stroke guaranteeing a satisfactory phase of filling of the mould.

Such an arrangement is known in particular from EP-A-0 734 801. The assembly for controlling the stopper, described in this document, comprises a drive shaft free to slide in a movement of translation with respect to a guiding assembly.

This drive shaft is fast with an intermediate arm directly supporting the stopper. A rotary servo-motor is also provided, as well as a device for

converting the rotational movement, imparted by this motor, into a movement of translation of the shaft.

More precisely, this movement converting device is in the form of a screw jack. It should, moreover, be noted that the motor is offset laterally with respect to the drive shaft, with reference to the principal direction of the latter.

However, this known solution presents certain drawbacks.

For example, the assembly controlling the stopper presents relatively large dimensions. Furthermore, it is necessary to provide as many motors as guiding members, which is disadvantageous from the economic standpoint.

It is an object of the present invention to overcome the different drawbacks of the prior art set forth hereinabove.

SUMMARY OF THE INVENTION

To that end, it relates to an assembly for controlling a stopper for a continuous casting installation, comprising a guiding assembly, a shaft for driving the stopper, adapted to move in translation with respect to the guiding assembly, a motor, presenting a rotary shaft, as well as means adapted to convert the rotational movement of the motor into a movement of translation of the drive shaft, characterized in that means are provided, allowing the removable fixation of the motor on the movement converting means, with the result that the motor is adapted to present a position of engagement and a position of rest, and in that, in the position of engagement, the rotary pin of the motor extends substantially in a principal direction of the drive shaft.

According to other characteristics of the invention:

- the removable fixation means are of the bayonet type.
- the bayonet-type fixation means comprise at least one stud, mounted on the guiding assembly, adapted to cooperate with at least one notch made in a linking piece, fast in translation with the motor.

- in the position of engagement, the or each stud is received in a corresponding cavity of the notch, which cavity is bordered by an intermediate neck.

- return means are provided, particularly elastic ones, adapted to return each stud axially towards the bottom of a corresponding cavity so as to prevent any untimely disconnection between the motor and the movement converting means.

- the motor is received at least partly in a housing, particularly provided with handles for handling.

- in the position of engagement, the housing lies approximately in line with the guiding assembly.

- in the position of engagement, the housing is arranged below the guiding assembly.

- the linking piece is mounted on said housing.

- the linking piece is cylindrical and it is adapted to penetrate at least partially in a housing of the guiding assembly.

- the rotary shaft of the motor extends at least partially in the interior volume of said linking piece.

- the movement converting means comprise a jack, particularly a screw jack, presenting a pin adapted to be driven in rotation by the rotary shaft of the motor, and means for temporarily coupling this pin and this shaft are provided.

- the temporary coupling means comprise two coupling members adapted to mesh mutually, temporarily, each coupling member being mounted on the pin or on the shaft.

- the coupling members are splined.

- one of the coupling members is fast with a flexible housing adapted to receive the other coupling member, in the position of mutual mesh of these two members.

The invention also relates to a continuous casting installation comprising a tundish, which is adapted to receive molten metal and which is provided with an orifice ensuring flow of this molten metal, a mould disposed downstream of this orifice, so as to be able to collect this molten metal, a stopper intended to selectively obturate this orifice, as well as an assembly for controlling this stopper, characterized in that this control assembly is as defined hereinabove.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described hereinafter with reference to the accompanying drawings, given solely by way of non-limiting example, in which:

Figure 1 is a general view illustrating a continuous casting installation according to the invention.

Figure 2 is a front view illustrating a control assembly belonging to the continuous casting installation of Figure 1.

Figure 3 is a side view in section illustrating the control assembly of Figure 2.

Figure 4 is a view on a larger scale illustrating a part of this control assembly, and

Figure 5 is a view in longitudinal section illustrating a linking piece belonging to the control assembly of Figures 2 to 4.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to the drawings, the continuous casting installation illustrated in Figure 1 comprises a tundish 2 which is filled with molten metal 4,

for example steel. The latter has been poured into the tundish from a ladle (not shown).

The bottom of this tundish is closed, in known manner, by a stopper 6 or stopper, which defines a lower orifice for passage of the metal, also called nozzle 8. This stopper may be driven along its principal axis, namely vertically in Figure 1, via a control assembly 10, or actuator, which will be described more precisely hereinafter.

This control assembly 10 comprises in particular a drive shaft 12 which may be displaced in translation in the direction of arrow F, in the present case vertically. This movement of the shaft 12 then induces a displacement of the stopper 6, materialized by vertical arrow F', via an intermediate arm 14.

The walls of the nozzle 8 are, furthermore, provided with a tube 16, made of a refractory material, which opens out in a mould 18. The latter receives a dummy bar (not shown), intended to be progressively withdrawn in order to ensure in known manner the extraction of a bar of solidified metal, likewise not shown.

Figures 2 to 5 illustrate the control assembly 10 in greater detail.

They show the shaft 12 of which the principal axis, vertical in the present case, is given reference A, as well as the intermediate arm 14, illustrated partially. The control assembly also comprises a fixed guiding assembly, of conventional type, which is generally designated by reference 20.

This assembly 20 presents a cylindrical body 22 on which are added flanges 24 allowing fixation on a plate 26 fast with the tundish 2. This cylindrical body 22 contains, in manner known *per se*, two ball-bearing bushes 28 as well as a device 30 conventionally preventing rotation of the shaft 12 about its vertical axis A.

The cylindrical body 22 is screwed, at its lower end, on a base 32, which is itself extended, opposite the cylindrical body, by an annular skirt 34. The latter thus defines, with the opposite walls of the base 32, a housing 36 placed in communication with a central opening 38 hollowed out axially in the base 32.

Furthermore, the walls of the skirt 34 bear studs 40 extending radially towards the inside. The function of these studs 40, which are provided to be three in number in the present case, will be explained hereinbelow.

In addition, the control assembly 10 comprises a motor 42 of conventional type, provided with a vertically extending rotary shaft 44. This motor is received partially in a housing 46, equipped with handles 48, as well as with a current supply 50.

This housing 46 is closed, in its upper part facing the cylindrical body 22, with a cover 52 in which is hollowed a central orifice for passage of the shaft 44. The latter is fast, via a key 54, with a first coupling member 56 received in a flexible housing 58, which will both be described in greater detail hereinafter.

This housing 58 is disposed in the interior volume of a linking piece 60, of cylindrical shape, which is fixed on the motor 42 by any appropriate means. As will be shown more particularly in Figure 5, the wall of this linking piece 60 has different notches 62 hollowed out therein, which are provided in a number corresponding to that of the studs 40.

More precisely, each notch 62, which is substantially in the form of an L, opens out axially at the level of the end of the linking piece 60 opposite the cover. This notch extends in a radial groove 64 which defines an end cavity 66, bordered by an intermediate neck 68.

The control assembly also comprises means for converting the rotational movement of the motor 42 into a movement of translation of the shaft 12.

More precisely, these means comprise a screw jack 70, known *per se*, which is housed principally in the cylindrical body 22 of the guiding assembly 20. The pin 72 of this jack 70, which traverses the base 32, is fast, via a key 74, with a second coupling member 76. This pin 72 which may be driven by the shaft 44 of the motor 42, is adapted to cooperate, in conventional manner, with a nut 78 fast with the drive shaft 12.

The two coupling members 56 and 76 present splines, which, in two's, define recesses. In service, the splines of one of the two members conventionally penetrate in the recesses of the other, with the result that there is a possibility of temporary coupling, with disengagement, between these two members 56 and 76.

It should be noted that member 56 is permanently housed in the flexible housing 58, while member 76 is adapted to penetrate in this housing temporarily. Finally, an elastic element 80 is provided, in the present case a spring lock washer, intended to return the coupling member 76 downwardly.

Functioning of the control assembly 10 described hereinabove will now be explained.

When the motor 42 is disconnected from the drive shaft 12, the operator has available, on the one hand, the afore-mentioned motor, which is housed in its caisson 46 provided with the handles 48 for handling, the coupling member 56 being accessible. On the other hand, the coupling member 76, present at the lower end of the pin of the jack 70, is also accessible.

The housing 46 is then to be manipulated, thanks to the handles 48, in a substantially upwardly directed movement of translation, so as firstly to engage the linking piece 60 in the housing 36.

At a given instant of this translation, a slight rotation, close to some degrees, is, if necessary, effected so as to ensure the cooperation of the two

splined coupling members 56 and 76. Consequently, the member 76 is then received in the interior volume of the supple housing 58, itself fast with the first coupling member 56.

Then, the upward translation of the caisson 46 continuing, the studs 40 are received in the vicinity of the opening of the different notches 62, arranged in this linking piece 60. These studs 40 then advance axially with respect to these notches, in the direction of arrow $\underline{f}_1$ shown in Figure 5.

When the studs come into axial abutment against the walls of the notches 62, it is then question of pivoting the housing 46. This thus induces an advance of the studs 40 along the grooves 64, in the direction of arrow $\underline{f}_2$ shown in Figure 5.

At the end of this movement of pivoting, each stud 40 is received in a corresponding cavity 66, after having passed over an intermediate neck 68. It should be noted that the spring washer 80 ensures an effect of axial return of each stud 40 to the bottom of the cavity 66, in the direction of arrow $\underline{f}_3$ of this same Figure 5. This thus prevents any untimely emergence of this stud 40 from its cavity 66.

In this way, the motor 42 may be removably fixed on the pin 72 of the screw jack 70. Consequently, this motor has two positions, namely a position of engagement, in which the two couplings 56 and 76 cooperate mutually, and a position of rest, in which the afore-mentioned couplings are distant from each other.

Furthermore, in the example described and shown, the means for fixing this motor 42 on this jack 70 are of bayonet type. In effect, they employ a movement of translation, combined with a movement of rotation of the motor with respect to this jack.

In service, in the position of engagement set forth hereinabove, the shaft 44 of the motor 42 drives the shaft 12, via the movement converting means, which comprise the two coupling members 56 and 76, as well as the screw jack 70. In this position of engagement, the rotary shaft 44 of the motor 42 extends substantially along the principal axis A of the drive shaft 12.

Furthermore, the housing 46, in which the motor 42 is received, is located below the cylindrical body 22, substantially in line therewith. This is advantageous, in terms of compactness of the assembly 10 controlling the stopper 6.

Finally, it should be noted that this control assembly 10 is provided with a lever (not shown), conventionally intended for moving the drive shaft 12 by hand. This is to be compared with the teaching of EP-A-0 734 801, in which the device for manually driving the stopper is constituted by a wheel coupled to a spindle.

Such a system cannot be used in casting, as the speed of displacement of the stopper is very limited. It is thus impossible to effect a manual start up of a casting with such a device, being given that the initial opening of the stopper, of the order of 15 to 20 mm, during start up, must be effected in less than a second.

This invention makes it possible to attain the objects set forth hereinabove.

In effect, as has been seen hereinabove, the compactness of the control assembly according to the invention is noteworthy in service. This is to be compared with the prior art in which the motor is offset laterally with respect to the guiding assembly.

Furthermore, the means for removably fixing the motor on the screw jack allow the latter to be rapidly dismantled.

Consequently, it is not necessary to have available as many motors as guiding assemblies, the motor being reserved solely for the step of casting. In other words, the guiding assemblies which are located at other stations of the continuous casting, such as assembly, dismantling, preheating or cooling, do not need to be provided with a corresponding motor.

The latter measure thus appears particularly advantageous, from the economic standpoint.

Finally, in the arrangement of the invention, emergency closure of the stopper is effected by gravity, upon simple de-activation of the motor. The weight of the mobile system, comprising the shaft, the arm and the stopper, thus suffices to cause the stopper to descend so as to allow such an emergency closure.

This is to be compared with EP-A-0 734 801 in which an electric resource by accumulation is employed, which operates the whole motorization chain, namely the electronic control device, the cables, the motor and the spindle.

Breakdown of one of these members, such as the tearing of a cable or a motor breakdown, thus renders any emergency closure impossible.